

Probability and Statistics

Data resources from the Internet, statistical software, and graphing calculators with statistical features are essential to the instruction and assessment of probability and statistics.

I. Descriptive Statistics

A. Gathering Data

1. Distinguish among surveys, observational studies, and controlled experiments and evaluate the quality of each.
2. Evaluate the legitimacy of conclusions about the population based on the sample(s) studied.
3. Analyze precision, accuracy, and approximate error in measurement situations.
4. Identify two or more experimental treatments (or conditions) to be compared and the sources of variation to be controlled.
5. Compare the responses of a group that gets treatment with those of a control group that does not.
6. Given a problem situation, describe the basic principles of experimental design (control, randomization, and replication).
7. Given a problem situation, evaluate whether conclusions drawn are based on randomization and control.

B. Defining Data

1. Given a problem situation, identify variables as categorical or measurement (discrete and random).
2. Given a problem situation, distinguish between independent/explanatory and dependent/response variables.

C. Displaying Data

1. Represent, display, and interpret data using scatterplots, bar graphs, stem-and-leaf plots, and box-and-whiskers diagrams, including representations on graphing calculators and computers.
2. Display univariate data in a problem situation with parallel box plots, histogram(s), or stem-and-leaf plots.
3. Display variables in a two-way table.

D. Computing Statistics

1. Given a problem situation, identify each variable as a statistic or a parameter.
2. Calculate measures of center and spread for univariate statistics.
3. Calculate position measures (percentiles and standardized values).
4. Calculate marginal distributions in a two-way table.
5. Determine positive, negative, or no correlation between bivariate statistics.

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II. Data Analysis

A. Shape of the Data

1. Given a problem situation, select the appropriate display and describe the distribution's overall shape and characteristics.
2. Based on the shape of the distribution, determine how the measures of center and spread are related to each other.
3. Apply the empirical rule to data displaying a normal distribution.

B. Correlation and Regression

1. Interpret the value of the correlation coefficient as it pertains to the relationship between the two variables.
2. Write a linear equation that fits a data set, check the model for "goodness of fit," and make predictions using the model.
3. Given a problem situation, display a scatterplot, describe its shape (linear, quadratic, or exponential), and calculate correlation coefficients, regression coefficients, and regression equations.
4. Given a problem situation with one variable as categorical and the other as measurement, compare the categorical variables using the appropriate display for the measurement variables and draw conclusions from those comparisons.

C. Transformation of Data

1. Describe the effect of transformations of data on measures of central tendency and variability.
2. Describe the effect of transformations of data on the shape of the data's distribution.

D. Functions to Model Data

1. Draw a line-of-best-fit or a curve-of-best-fit for a scatterplot.
2. Determine the function that models the data best.

III. Inferences and Predictions

A. Simulations

1. Conduct simulations to collect random sample statistics and examine the variability of them from a known population.
2. Conduct simulations to construct sampling distributions.

B. Sampling

1. Use the properties of the normal curve to describe how sample data estimates the population mean and standard deviation.
2. Examine sampling distributions to make inferences and predictions about population parameters.

C. Validity of Statistical Studies

1. Given a published report based on data, determine the design of the study, the appropriateness of the data analysis, and the validity of the conclusions.
2. Given a published report based on data, interpret the results.

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D. Statistics in the Workplace

1. Apply confidence intervals and margins of error to workplace processes.
2. Interpret the results of hypothesis testing for a single proportion or mean.

IV. Basic Concepts of Probability

A. Sample Spaces and Probability Distributions

1. Describe all possible outcomes of an event containing a finite number of outcomes.
2. Determine a sample space for selected experiments and represent it in the form of a list, chart, picture, or tree diagram.
3. Determine whether or not an experiment is binomial and, if so, apply the binomial distribution formula.

B. Empirical Probability Distributions

1. Use simulations to construct empirical probability distributions.
2. Interpret the results in the context of an applied problem.

C. Expected Value

1. Given a problem situation, delineate the sample space and conduct simulations to calculate the expected value of the random variables.
2. Given a problem situation, interpret the expected value of the random variables.

D. Theoretical Probability

1. Identify mutually exclusive, joint, and independent events.
2. Recognize and compute conditional probability.
3. Recognize and compute addition and multiplication rules.

E. Compound Event

1. Calculate probabilities of a compound event empirically and theoretically.